of ice, found the value 60,000. Reusch ('Nature,' vol. 21, p. 504), by experimenting on the sonorous vibrations of rectangular plates of ice, found Young's modulus to be 23,632 kilos. per sq. cm. (this last method seems rather dangerous). In attempting to devise an imaginary system of strains sufficiently great to render such a recovery as 0·1 cm. possible, we are soon brought up by the breaking tension of ice. Direct experiments by Moseley give this as 7 or 8 kilos. per sq. cm., and Kidd and myself found it in one case to be 8·3 kilos. per sq. cm., but the fact that the bar of ice in Exp. (11) bore the weight of 2·5 kilos. before any plastic strains had taken place brings it out greater than 15·5 kilos. per sq. cm., and the bar in Exp. (13) was able to endure an even greater stress.

A similar discrepancy has been noticed in the case of cast iron (Rankine, 'App. Mechanics,' § 297).

Using the latitude given by the uncertain values of the constants to the utmost, I have not been able to devise any system of elastic strains which could possibly make the bar rise 0·01 cm., and there is no reason to suppose that the unknown system of strains actually occurring in the experiments would be exceptionally well adapted to such a purpose. I conclude, then, that we have to deal with a real tendency of the forcibly displaced sliding layers to slide back. The rate of recovery, rapid at first, soon falls off. Thus in Exp. (10) there was a recovery of 0·046 mm. in the first 18 minutes, and only 0·021 in the next 58. In Exp. (15) after 0·014 in the first 11 minutes, and the same in the next 31, the motion probably came to a standstill after a few hours, practically, if not absolutely. Thus in Exp. (12) the bar was left with no weight on for 12 hours, and the recovery was only 0·072 mm.

[Mr. McConnel died suddenly at Davos while engaged on the foregoing paper, which has been printed from his rough copy with some few alterations of no great importance. I thought it better to do this than to attempt to edit it; though I know from his last letters to me that the author would have himself, if he had lived, been able to leave it in a more finished state than that in which it now appears. —R. T. G.]

II. "On the Effect of Temperature upon the Refractive Index of certain Liquids." By W. CASSIE, M.A. Communicated by Professor J. J. THOMSON, F.R.S. Received February 19, 1891.

In my paper "On the Effect of Temperature on the Specific Inductive Capacity of a Dielectric" ('Phil. Trans.,' A, 1890), the

values obtained for the temperature-variation of specific inductive capacity of four of the liquid dielectrics investigated were compared with the corresponding values of the temperature-variation of refractive index found by Messrs. Dale and Gladstone.* And the relations between these two quantities, though not in accordance with Clerk Maxwell's electromagnetic theory of light, were near enough to make it worth while to try whether the divergence from theory might not be due to differences in composition. Accordingly I measured the rate of change of refractive index with temperature for the same specimens of the liquids as were used in the electrical experiments. In the case of olive oil, however, the original supply could not be found. The results obtained are very close to Messrs. Dale and Gladstone's for those of the liquids they had examined, and for the others the optical effect shows a similar divergence from Maxwell's theoretical relation. And considering the enormous difference in the rapidity of the electrical and optical effects, this is not surprising.

The change of refractive index was measured by observing with a spectrometer the minimum deviation of the D lines for a bottle prism filled with the liquid. The observations were taken at two temperatures, viz., that of the room, 16° or 17° C., and a higher temperature, about 40° C., obtained by heating the prism and its contents in warm water. The results are shown in the following table, the last column giving the values of Messrs. Dale and Gladstone:—

	Rate of change per degree centigrade of		
	Specific inductive capacity.	Refractive index.	Refractive index (D and G).
Turpentine	− ·0012	− ·0003	− ·00033
Carbon bisulphide	− ·004	− ·0006	—
Glycerine	− ·006	− ·0002	− ·00018
Benzoline	− ·0006	− ·00037	− ·00037
Benzine	− ·0014	− ·00043	− ·00042
Paraffin	+ ·0023	− ·00017	—

In the case of glass, the change of refractive index with temperature was found by Stefan† to be 0·0000023 per degree centigrade, a quantity of quite a different order from 0·002, the rate of change of specific inductive capacity. And in view of the influence of the time of charging, even when extremely short, upon the specific inductive

* Results collected in Watts's 'Dict. of Chem.,' vol. 3.

† 'Wien., Akad. Sitzber.,' vol. 63, Abth. 2.

capacity of glass revealed by Professor J. J. Thomson's experiments,* this is only what might be expected.

III. "On the Bisulphite Compounds of Alizarin-blue and Cœrulin as Sensitisers for Rays of Low Refrangibility." By GEORGE HIGGS. Communicated by LORD RAYLEIGH, Sec. R.S. Received February 19, 1891.

The determination of the relative wave-lengths of the Fraunhofer lines, by photographing all the orders of spectra given by any particular grating, includes certain subjects which present more or less difficulty, and that of selecting or producing a dye-bath adapted to the requirements of the two or more orders comprising the subject is intimately connected with that of the choice of absorbing media.

Having been engaged for some time in investigations of this nature, I had occasion, during the summer of 1889, to require an impression of the 2nd order, about λ 3300, contiguous with that of the red end of the 1st order, and finding that the ordinate of an actinic curve for a plate immersed in a very dilute alcoholic ammoniacal solution of cyanin (1 : 30,000), reduced to about one-fourth of that for an unprepared plate, I abandoned its use for this purpose. The results appeared to be unaffected by the addition of quinine.

Subsequently, induline, cœrulin, alizarin-blue, and the bisulphite compounds of the two latter were used. When obtained in a state of sufficient purity the alizarin-blue S leaves little or nothing to be desired, for, whilst possessing, in a high degree, sensitising properties for rays throughout the region comprised between λ 6200 and 8000, it does not, like cyanin, lower the sensitiveness to the violet and ultra-violet.

The following is one of the processes I employed in the preparation of the dye-stuff in a pure state :—

To a saturated solution of sodium bisulphite in a mortar is added alizarin-blue paste. This is disintegrated with a pestle, and poured into a glass vessel capable of holding an additional quantity of sodium bisulphite, in all 10 parts of the paste to 20 parts of bisulphite, and another 10 parts of water. The vessel is well stoppered, set aside in a cool place for five or six weeks, and shaken daily, but left undisturbed during the last eight or ten days.

The solution is decanted, filtered, and treated with alcohol, to precipitate the greater portion of the remaining sodium bisulphite. 50 parts of water are now added with a sufficiency of sodium chloride to form a concentrated solution. Again set aside in an open-mouthed

* 'Roy. Soc. Proc.,' vol. 46.